THE

Malayan Agricultural Journal.

Vol. X. FEBRUARY, 1922. No. 2.

EDITORIAL NOTES.

ADVISORY COMMITTEE 1922.

THE following gentlemen will constitute the Advisory Committee, Department of Agriculture, for the year 1922.

The Secretary for Agriculture (Chairman), The Hon. Mr. R. C. M. Kindersley, Messrs. W. S. Cookson, W. R. Shelton-Agar, S. Wierman, M. J. Kennaway and R. Napier Hendrie.

PROPAGANDA.

Illustrated Posters on the Black Beetle and Red Stripe Weevil of coconuts, and on the Padi Borer (*Schnoebius bipunctifer*) "Ulat Layar" or "Ulat Gading" printed in Malay and in Tamil have been distributed throughout Malaya; these notices contain brief life histories of the pests, together with simple instructions as to their control.

Several Cinema Films were prepared in connection with the Malaya-Borneo Exhibition; certain of these deal with pests of rubber and their treatment, others with cultivation of crops. It is proposed to utilise these after the Exhibition to illustrate lectures in various parts of the country and for this purpose the Department of Agriculture hopes at a later date to obtain a portable cinema lantern.

MARKETS.

Numerous enquiries from abroad have been received of late as to whether Malaya is in a position to export kapok. This demonstrates a world-wide demand for this commodity. A recent enquiry from a firm in Singapore states that there are enquiries for kapok from New Zealand. If interested readers will correspond with the Department, the latter will be pleased to place them in touch with the firm in question. Please quote No. 59 in D.A. 525/22 in this connection.

An enquiry has been received from a firm in London who would like a good-sized sample of Roselle Fibre, and who enquire what quantity of the Fibre would be available in this country. The Department of Agriculture has arranged to send the sample, but

growers of the Fibre who wish to communicate with the firm are asked to write to the Secretary for Agriculture quoting as a reference D. A. 1202/1922.

COCONUT SPIKE MOTH.

It is particularly requested that managers of Estates who notice damaged coconut spikes, and who are not acquainted with the cause of the injury, will forward these for report (labelled Entomological Specimens), to the Secretary for Agriculture.

SOME PLANT OILS OF MALAYA, THEIR EXTRACTION AND USES*

By C.D.V. Georgi.

INTRODUCTION.

THE objects of this article are to bring to notice some of the more important oils which can be extracted from trees and plants growing in this country, to describe and illustrate the various methods employed, and finally to state their commercial uses.

Malaya, like all tropical countries, is particularly rich in oil-bearing plants which hitherto have been exploited only to a small extent, but it is thought that a greater number will receive attention in the future.

The term "Plant Oils" includes two different types of oils, namely fixed oils or fats, and volatile or essential oils. The fixed oils or fats are those which cannot be volatilised without decomposition, while the opposite applies to the volatile or essential oils.

This difference can also be illustrated by a simple experiment. A drop of a fixed oil, such as castor oil, produces on a piece of paper a translucent spot which, even if warmed, does not disappear on exposure to air, (it would decompose if heated too much); a drop of essential oil, such as citronella or lemon oil, however, will give a similar translucent spot, but this will disappear on exposure to air, at the same time a strong and characteristic odour will be emitted, which serves as a further distinction between fixed and volatile oils, fixed oils in the pure state being odourless.

As, moreover, the methods of extraction of these oils, their composition and the uses to which they are put are dissimilar they will be considered separately.

FIXED OILS OR FATS.

Description and Classification. In plants, these oils and fats are found in considerable quantities in the seed, where, together with starch and proteins, they serve as food which would be required were the seed allowed to develop.

A fixed oil or fat cannot be regarded as a definite chemical compound but as a mixture of such, the proportion of the constituents varying according to the conditions under which the plant is grown, e.g. the soil, climate, altitude and other factors; generally however,

*Note:—This article is based on a lecture and demonstration given by the writer at the 3rd Annual Conference of Malay Officers of the Agricultural Department September 1921.

such an oil or fat consists of a mixture of glycerides of fatty acids with which a small amount of free fatty acids may also be associated.

The term "glyceride of fatty acid" indicates the chemical compound resulting from the action of glycerol on a fatty acid, in other words, a glycerol salt. To take a simple example, in the same way that sodium chloride (salt) may be regarded as one of the products of the action of caustic soda (base) on hydrochloric acid (acid), so a fixed oil or fat (salt) may be looked upon as one of the products of the action of glycerol (base) on a fatty acid (acid), or written as a chemical equation :—

Caustic Soda + Hydrochloric Acid = Sodium Chloride (Common Salt) + Water.

Glycerol + Fatty Acid = Glyceride of Fatty Acid (Oil or Fat) + Water.

The question of the free fatty acid is very important, since upon the amount present in the oil or fat depends to a large extent its possible uses and consequently its value. The reduction of this acidity to a minimum is one of the chief points to be considered in the extraction.

No sharp distinction can be made between oils and fats, for an oil when cooled sufficiently becomes a fat and a fat when melted becomes an oil, it is merely a question of temperature. A general rule in Europe is to apply the term "oil" to those which are fluid, and the term "fat" to those which are solid at a temperature of 20° C, but this does not hold good in Malaya where the normal temperature is above this figure.

In adopting the modern system of distinction between fats and oils, it is customary to sub-divide the oils further according to whether they are drying, semi-drying, or non-drying and to treat fats as a class by themselves.

It is well known that, when certain oils are exposed to the air, the surface of the oil films over (solidifies) or in other words the oil is said to "dry". This drying effect is due to the absorption of oxygen from the air, because no such change will take place if the oil be kept in a receptacle from which air is excluded or which is filled with an inert gas, such as nitrogen. Some oils, such as linseed oil, dry at a normal temperature, while others, such as candle nut, dry only after heating.

To determine experimentally the amount of oxygen which a given amount of oil could absorb would be very difficult, but as it has been found that the quantity of iodine which an oil can absorb under standard conditions stands in very close relationship to the quantity of oxygen which it is capable of absorbing, a general classification based on what are termed "Iodine Values" has been adopted and oils are called drying, semi-drying or non-drying according to their high or low "Iodine Values".

This property of drying also determines the use to which the oil can be put, as oils which dry well are largely used in the manufacture of paints and varnishes, the film produced as a result of the "drying" forming the protective coating on the material painted.

Preliminary Treatment and Extraction.—Although there are only two methods employed for the extraction of oil from seeds and fruits, namely by expression or by using a chemical solvent, it will be seen from the above list that the preliminary treatment must vary with the particular type of seed or fruit and that machinery must be chosen accordingly. Thus a soft fruit such as African oil palm, which yields two different oils, namely palm oil and palm kernel oil, requires very different treatment from rubber seed or castor seed. Further in order to obtain the best quality oil, care must be taken to ensure that the fruits or seeds are gathered when ripe and stored under proper conditions or treated without delay according to circumstances. Fruits such as the African oil palm must to expressed as soon as they are ripe, otherwise if the fruit is allowed to become overripe and moist the enzymes or ferments in the fruit act on the oil, producing large quantities of fatty acids far in excess of the very small amounts present in the ripe fruit. Similarly, seeds such as those of rubber or castor must be stored dry, otherwise they will tend to heat, with the result that the fat splitting ferments will act on the oil, producing, as in the case of the palm oil, large quantities of fatty acids, with a consequent deterioration in the value of the oil.

When extracting the oil by the method of expression the seeds or nuts are first subjected to a process known as decortication, if the removal of husks or shells is necessary. The oil cells in the seeds are then ruptured by crushing the material to a coarse meal by passing it through a series of rollers or millstones. The meal is then heated to about 50° C and pressed in some kind of press, hydraulic generally, as a result of which the greater part of the oil is squeezed out and a cake containing the remainder is left in the press.

"Expellers," machines working on a screw principle, which combine the two operations of crushing and expression to a certain extent, may also be employed.

Occasionally, the crushed meal must be expressed cold as, when pressed hot, some deleterious substance may pass into the oil which may either render it unfit for the proposed use or decrease its commercial value. An instance of this is the extraction of medicinal castor oil which is always "cold drawn"; if pressed hot, the poisonous principle, ricine, will pass into the oil, thereby rendering it useless for medicinal purposes.

Extraction in the cold does not yield as much oil as when carried out in the hot, for in the cold the oil is more viscous and flows less readily, so that a considerably larger quantity remains in the cake; hence it is customary after an expression in the cold to heat the meal and press the heated meal thus obtaining a further quantity of oil which, although of poorer quality can be utilised in other ways. If

the oil be very viscous or the meal particularly rich in oil, the meal may be re-heated and pressed a third time.

When pressing the meal the pressure should be increased gradually, so that the oil may have time to flow out, otherwise the oil is liable to squirt and carry away with it various impurities such as albuminous matter,

The extraction of oil by chemical solvents depends upon the fact that oils and fats are dissolved by certain liquids, such as petroleum ether, carbon tetra-chloride, tri-chlor-ethylene and other solvents and can therefore be separated from the crushed seed by treating the latter, with one of these solvents.

The extraction can either be carried out in the cold or in the hot; if in the cold, the meal is placed in a series of closed vessels through which the solvent flows on the counter current principle, that is to say the meal that is almost exhausted comes in contact with the fresh solvent. The solution of extracted oil or fat is transferred to a steam-heated still where the volatile solvent is distilled off and recovered by condensation, the traces of solvent retained by the oil or fat being driven off by a current of steam.

Extraction in the hot, which is the usual method adopted, consists in boilling the solvent and passing the mixture of hot solvent and vapour through the meal contained in a separate vessel. The solvent charged with oil is collected in another vessel, where the solvent is again vaporised, leaving the oil; the solvent vapours are condensed and used over again for a fresh charge of meal as in the cold process.

It must not be thought that, because these two processes are so different in principle, they cannot be combined. On the contrary the two are frequently worked together in the same factory, seeds or meal are pressed first and then treated by the solvent process to recover the whole of the remainder of the oil. Although it is possible to obtain only about 85—90 per cent. of the oil content of seeds or meal by expression, with extraction it is possible to obtain the whole of the oil.

Having thus described the nature, classification and methods of extraction of a fixed oil or fat, a list of some of the more common ones found in this country will now be given, after which the special details regarding their extraction will be considered.

List of Fixed Oils and Fats.

Fixed oil or Fat.	English Name.	Malay Name.
Drying oil ...	Rubber Seed Oil	... Minyak Bijek Getah
	Candle Nut Oil	... Minyak Buah Keras
Non-drying Oil	Castor Oil	... Minyak Jarak

Fats	...	Coconut Oil	...	Minyak Kelapa
		Palm Oil		
		Palm Kernel Oil		
		Tengkawang Fat	...	Minyak pokok.

Rubber Seed Oil.—Rubber seeds contain between 56 and 58 per cent. of kernels only, it is advisable therefore to decorticate before pressing, as otherwise the press is partly filled with material which contains no oil. Further the meal or cake from undercorticated seed is unsuitable for cattle feeding purposes.

Candle Nut Oil.—In the case of the candle nut, the kernel is enclosed in a very hard thick shell, which constitutes nearly 70 per cent. by weight of the nut, so that the nuts must be cracked and the kernels extracted before pressing. Cracking by hand with the aid of a hammer is a very tedious process as when cracked the kernel breaks into a number of small pieces all of which have to be picked out with a knife.

Various methods, other than the use of nut-cracking machines, which are unknown so far in this country, have been suggested to facilitate the extraction of the unbroken kernel. The most satisfactory method consists in heating the nuts to a temperature of 130—140°C for about 1½ hours and then plunging into cold water. After soaking for some hours it will be found that about 70 to 75 per cent. of the nuts can be cracked between the fingers and the kernels removed whole or in two pieces, and that of the remaining 30 per cent. all can be broken by tapping with a wooden pestle.

Castor Oil.—The preliminary treatment of castor oil seeds differs somewhat from that of other oil seeds as, the kernels being so soft, the grinding must be very light. It is customary to heat the seeds to about 50° C to reduce the viscosity of the oil and then commence pressing, but if medicinal oil is required seeds should be decorticated first and pressed in the cold. Castor oil cake is one to which the solvent method of extraction can be conveniently applied as there may be as much as 15 or 16 per cent. remaining after pressing, this large quantity being almost entirely due to the high viscosity of the oil.

Coconut Oil.—The preliminary treatment of coconuts and the conversion of the kernel into copra are so familiar that little need be said about them, except that drying by hot air on the counter current principle is preferable to sun drying. Moist copra is readily attacked by fungi, so that care must be taken to ensure that the percentage of water is kept as low as possible, about 4 per cent, otherwise the fungi will cause a large increase in the amount of free fatty acid, with consequent deterioration in the value of the oil.

The copra is ground in a special machine called a disintegrator and then expressed twice at a temperature of about 70° C, either in a hydraulic press or in an expeller and then a press. Two expressions are necessary on account of the high oil content.

Palm Oil and Palm Kernel Oil.—The African oil palm fruit contains two distinct oils, the palm oil, present in the flesh (pericarp) of the fruit, and palm kernel oil present in the kernel, and therefore the separation of the flesh and the nut is the first point for consideration. Further, as there is also present a very active fat splitting enzyme or ferment it is of the utmost importance that fruits be treated fresh and ripe, and also that damaged fruits be kept separate; thus, when bringing the bunches into the factory they should be suspended until required for use, otherwise they will be bruised and large quantities of free fatty acids will develop. An actual instance of this development of fatty acid may be quoted. In March 1921 a quantity of the separate fruits was sent by rail from an estate in the Kuala Selangor district to the Department of Agriculture, about a week elapsing between the time of picking and the time of extraction; when the acidity of the oil was determined it was found to be about 25 per cent.

The flesh and kernels are separated in a machine called a depulper, which consists of a series of knives and cuts the flesh from the kernel. Before depulping, the fruit is heated and pressed, the object of the heating being to destroy the fat splitting enzyme and thus ensure an oil of very low acidity, and that of the preliminary pressing to remove as much of the oil as possible, thereby preventing contamination with albuminous and fibrous matter from prolonged contact with the pulp. After the depulping operation, the pulp is warmed again and subjected to a high pressure, about 3 tons per square inch, after which it serves as fuel for the boilers.

The extraction of palm kernel oil from the kernels is rather a lengthy and laborious process, as it involves the cracking of a hard nut and the removal of the kernel. Various machines have been constructed to facilitate this process, but up to the present none of them has given complete satisfaction. The kernels after removal from the shells are ground between rollers and expressed in hydraulic presses; the meal is pressed twice on account of the high oil content which is generally between 45 and 50 per cent.

Tengkawang Fat (*Borneo Tallow*).—This fat is obtained from the kernels of a large variety of plants belonging to the family of Dipterocarpus.

On account of its small distribution the extraction of the fat has not yet been worked out on a commercial scale, the methods at present in use being the primitive native ones, whereby the seeds are cracked by allowing the nuts to germinate, the kernals removed and pressed. The liquid fat is run into moulds made of hollow bamboo stems and consequently the commercial samples have a cylindrical shape (vide Lewkowitsch, Chemical Technology of Oils, Fats and Waxes Vol. II page 491).

Uses of Fixed Oils and Fats.—It is a difficult matter to enumerate all the uses which are found in commerce for the numerous

oils and fats and only the more important ones will be mentioned here.

Name of Oil or Fat.	Nature of Oil or Fat.	Uses.
Rubber Seed Oil ...	Drying ...	Paints, varnishes, soaps.
Candle Nut Oil ...	do. ...	Paints, varnishes, soaps, illuminant.
Castor Oil ...	Non-drying ...	Lubricant, soaps, leather manufacture, medicinal, dyeing industry.
Palm Oil ...	Fat ...	Edible, margarine, soaps, candles, lubricant, tinplate industry,
Coconut Oil ...	do. ...	Edible, margarine, soaps, illuminant.
Palm Kernel Oil ...	do. ...	Edible, margarine, soaps, candles.
Tengkawang Fat ...	do. ...	Soaps, candles.

From this table it will be seen that the most important uses of these oils are for edible purposes and soap manufacture. This is hardly to be wondered at when one considers the importance of oils as an article of human diet and also the large quantities of soaps required both in maintaining the body in a clean state and in the preparation of clothing and materials, raw wool, cotton, silk, all require large quantities of soap in order to prepare them for weaving.

Only the best quality oils and fats can be used for edible purposes, large amounts of free fatty acid would preclude a fat or oil from being utilised for this purpose, and render it fit only for soaps, just in the same way that a drying oil containing a large proportion of free fatty acid is unsuitable for a paint or varnish.

ESSENTIAL OILS.

Unlike fixed oils and fats, which occur usually only in the seeds or fruit of the plant, essential oils may occur in any part of a plant, the flowers, the leaves, the roots etc.; thus for example, in the case of the rose, the oil is found in the petals and in the case of citronella grass in the leaves. Occasionally, the essential oil is not found as such in the plant, but is formed as a result of the decomposition of some other compound by an enzyme or ferment present in the plant.

Essential oils occur in much smaller quantities in a plant than fixed oils; it is seldom that the yield, calculated on the weight of raw material, exceeds 3 to 5 per cent, frequently it is less than 1 per cent.

Essential oils are very seldom definite chemical compounds, but are generally mixtures of highly complex organic compounds, some-

times hydrocarbons (substances composed of carbon and hydrogen) but more often alcohols, aldehydes and esters.

The proportions of the various constituents vary too, according to the conditions under which the plants are grown; thus a change of soil and climate will often have a marked effect both on the quality and quantity of the oil content.

Essential oils are generally classified according to the botanical orders of the plants from which they are obtained, as it is found that plants from the same family yield essential oils, which have very closely allied chemical compounds as their chief constituents.

It is beyond the scope of this article to deal with such a classification for, if a complete list were given it would be necessary to include every odouriferous plant in Malaya, since they all probably contain some essential oil, in many cases in very minute quantities only.

The only essential oils which will be discussed in this article are two of those belonging to the Natural Order of Graminae, notably citronella and lemon grass oil, both of which are well known in Malaya and with which experiments have been made in the past year regarding their commercial possibilities.

Preliminary Treatment and Extraction.—The treatment to which the grass must be subjected is the same in both cases and consists in steam distillation, a method in which the grass is packed into a boiler through which steam is passed. The oil being volatile, distils over with the steam; the combined vapours are then condensed, when the oil, not being miscible with the water, separates out, rising to the surface as in this case its density is lighter than that of water.

There are certain other details in the technique both as regards preliminary treatment and extraction which deserve attention, as it must be borne in mind that in dealing with essential oils the treatment to which plants are subjected must be carefully controlled.

The price of many essential oils depends upon the delicacy of their odour, and if the extraction be carelessly carried out, the odour may be impaired very considerably.

The grass should either be distilled fresh, or if this is not feasible it should be dried very carefully, and spread out in thin layers until required for use, thereby avoiding all chance of fermentation which would be caused if the grass were piled in heaps.

An effective condensing apparatus is necessary to ensure the vapour of the essential oil and steam being in contact as short a time as possible.

It has also been found that the time of distillation can be diminished very considerably, if the grass be first cut into lengths of six to nine inches.

Uses.—As citronella oil is one of the cheapest of the essential oils, and at the same time possesses a strong odour, apart from its use as a basis for cheap perfumes, this has led to its adoption as a perfume for all kinds of cheap soap which otherwise might possess a disagreable odour. It is also used to a certain extent as a mosquito preventive.

Lemon grass oil is a much more fragrant perfume and in addition to its use as such, it is extensively employed in the preparation of a compound called Ionone, which has an odour similar to violets and forms the basis of artificial violet perfumes.

Conclusions.—This brief account will be seen to bear out the statement made at the outset to the effect that Malaya is rich in oil bearing plants. It must not be thought that the list is exhaustive as there are many other oils which can be produced, but which have not been described, notably gingelly oil, cotton seed oil, kapok seed oil, and ground nut oil.

The writer is convinced however that there is no reason why after careful experimental cultivation and with adequate financial support, this country should not take a larger part in supplying quantities of various oils both for consumption in Malaya and for export.

RICE MILLING FOR ESTATES.

By H. W. Jack.

UNDER Editorial Notes in the Agricultural Bulletin for January, 1922 the Secretary for Agriculture pointed out the advantages that would result from installing small rice-mills on estates for supplying their coolies with rice.

The purchase of local padi, raw or parboiled and the hulling of it by estates would, apart from the advantages to the buyer, bring great benefits to this country. It would encourage padi cultivation and at the same time, keep in this country a large sum of money which now goes into the pockets of padi planters, dealers and others outside this country.

Furthermore, the use of estate-hulled rice would tend to reduce "beri-beri" which is a menace to certain sections of the local labour forces,—a question which every employer of labour must have at heart, and of which the most natural solution is the growing of our own rice supply as far as possible.

The hulling of rice by estates is not a difficult practice once the routine is properly established, whether hand or power machines are employed, and the following notes are intended to describe the necessary operations, to stimulate interest in estate milling and arouse inquiry.

The selection of the type of mill is a matter for each estate manager to decide, giving consideration to availability of power and the amount of rice required to supply his labour force. The same considerations apply to the size of store, the capacity of the soaking tank, boiling arrangements and area of drying floor required.

A. POWER MILLS.

1. The Engelberg Rice Huller and Polisher type No. 1:

This mill is obtainable through Messrs. Guthrie & Co., or Messrs. McAlister & Co., and appears to be similar to the "Planters Mill" No. 1 as shipped by Messrs. Douglas & Grant of Scotland whose agents are R. Young & Co., of Penang, except that the latter machine has a larger capacity and requires more power. The "Engelberg" mill has been erected by the Kedah Rubber Company on their estate near Parit Buntar, and the manager, Mr. J. W. Wilson, has kindly supplied all the figures quoted in connection with its erection and working, as actually incurred by that estate. The mill occupies little space, is easily erected, simple in its adjustments, only requires about 6—8 H. P. to drive and does not render the rice deleterious since the

light polishing it receives is hardly more than a means of separating the rice from the chaff.

Initial cost of erection of milling plant on Kedah Estate.

Purchase of mill (agents price) (makers price is $300 gold)	... ...	$750.00
One case spares	... ...	100.00
Erection of mill and mill room	... ...	180.00
Shafts, belting, pulleys etc.,	... ...	580.00
Drying floor	... ...	400.00
Soaking and parboiling arrangements	... ...	120.00
Padi store (60 ft. x 18 ft.)	... ...	1,200.00
	Total ...	$ 3,330.00

The cost of erecting the mill included the building of a mill room (12' x 10') adjacent to the rubber factory. In many cases the erection of a separate mill room would be unnecessary, as sufficient space in the factory would be available.

The cost of shafts, belting, pulleys etc., would vary greatly according to conditions obtaining in the factory. In the case quoted it was necessary to put in two counter shafts and the price included the cost of spare belting. In most rubber factories this item of expenditure would be materially reduced or possibly even halved.

A drying floor is necessary to ensure that the padi is thoroughly dry before milling. The cement floor on Kedah Estate covers some 1500 square feet and is ridged, the breadth of each ridge being about 10 feet and the difference in height between ridge and furrow being about 4 inches.

The padi is soaked and parboiled prior to milling to clean the padi and to render the hulling operation the easier. Soaking is done in a plain cemented tank having a capacity of 12 bags of padi and an outflow pipe at the bottom for changing the water. The arrangement for parboiling is simple and effective. Three large shallow iron pans (kwali) each capable of holding one bag of padi are mounted on a circular brick and cement oven, one fire being sufficient to heat the three pans at the same time, the whole arrangement being under cover.

The padi store is built mainly of bricks, cement and corrugated iron sheeting and would possibly cost more on other estates, where no clay suitable for making bricks is available and where the estate labour cannot make bricks or do the building.

On Kedah Estate, this mill is run for 2½ hours daily, and produces 150 gantangs of clean rice, (approximately 950 lbs) the padi being put through the mill twice, i. e. the " outturn " is a milling terms per hour of clean rice is roughly 60 gantangs.

The cost of milling, including soaking, parboiling, drying, milling and bagging but exclusive of depreciation of mill or European supervision, is 1.2 cents per gantang of rice, and the percentage of rice obtained from padi averages 44 (by volume).

The cost of padi delivered on the estate this season was 14 cents per gantang, so that the cost of rice works out at 33.7 cents per gantang as follows:

$2\frac{1}{3}$ gantangs padi	... ...	32.5 cts (actual)
Manufacture ...	... ...	1.2 cts
	Total ...	33.7 cts

The mill has been running daily for over six months and no repairs have yet been necessary.

In using this mill the routine may be briefly summarised as follows:—

(1) Soak padi 24 hours, changing the water at least twice.
(2) Parboil padi for 20 minutes, stirring all the time.
(3) Dry padi thoroughly (not less than 24 hours).
(4) Mill.
(5) Mill again.

2. The Engelberg Huller.

This machine is sold by the makers for $215 gold (local agents about $550.00) and is in all points the same as the one described above except that it does no polishing or separating of the rice from the chaff and thus necessitates the use of a winnower. Indeed a winnower, though not essential, is advantageously used with the Huller and Polisher also.

Hand winnowers are cheap, durable and effective and most Chinese carpenters can make them for $30—45.00, or failing the local "tukang," they can be made to order for estates through the Agricultural Department.

Power winnowers can, of course, be used also, but they are expensive and no more effective than hand machines.

3. The Improved Under-Runner Hulling Mill.

This machine is also sold by Messrs. Douglas & Grant (catalogue page B. 3.) through their local agents and would appear to be effective, though the writer has had no experience with it.

Like No. 2, above, it requires to be used with a winnower and a separator.

It is sold in four sizes of capacities varying from 300 --900 gantangs of padi per hour, that is, equal to an outturn of 120 —400 gantangs of clean rice.

The power required for the efficient running of the smallest size is only 2 H.P. and of the largest size 4½ H.P. and the machine costs approximately $600.00 (probably exclusive of commission.)

B. HAND POWER MACHINES.

The best of these is the Improved Hand Power Rice Huller as shipped by Messrs. Douglas & Grant (catalogue page R. 1) and is obtainable through McAlister & Co., or R. Young & Co.

This mill is a combined huller and winnower and is very effective if used in conjunction with a hand power "compartment separator" as specially designed for it by the makers. The "Compartment separator" divides the hulled from the unhulled rice after the first milling and the unhulled rice is passed through the mill a second time.

The mill is very simple in design, very compact, easily adjusted, strongly constructed and practically foolproof. The hopper is fitted with an efficient feeder which delivers the padi to the hulling discs in an even stream and a neat winnowing attachment blows away all the husk.

This mill is very suitable for small estates not requiring a large amount of rice per day as its outturn is only some 15 gantangs of rice per hour. The hand labour involved in working it is very light and it might also be adapted so as to be driven by a light motorcycle engine as the power required is less than 1 H.P.

Before using this mill care should be taken that the padi is clean i.e. free from foreign particles such as pieces of stones, nails etc., which are liable to damage the grinding discs.

The price for the machine is $400 approx: and spare parts including grinding discs can be supplied.

The hand power "compartment separator" designed for use with the mill costs $500/- and by using it, the grinding discs of the huller can be set so that practically no rice is broken, unless the padi used is of very inferior or mixed quality. The separator can deal with some 25 gantangs of milled rice per hour.

Any of the above-mentioned machines can be used for raw as well as for parboiled padi, but slightly more breakage of rice is usually experienced.

THE TREATMENT OF BUDDED HEVEA SEEDLINGS.

By J. N. Milsum.

IN a previous paper (1) it was stated that exact information as to the best system to be adopted to establish budded rubber stumps in the field was not available. Recent experiments conducted at the Kuala Lumpur Experimental Plantations have thrown considerable light on this and other matters connected with budding Hevea, and it is considered advisable to publish the results so far obtained. In addition, much useful information has been published in the 'Archief voor de Rubbercultur' (2), wherein Mr. F. W. Donkersloot discusses the vegetative reproduction of Hevea as an estate practice in Sumatra.

Time For Budding.

The highest percentage of successes in budding is obtained after the wintering period, when the sap is active. Budding should not be undertaken just before and during the wintering period of the mother trees. Equal success was obtained during June, July and August, but it was found that stumps budded during the last mentioned month were as far advanced as those budded earlier, when examined in October prior to transplanting. It is to be appreciated that though budding may be performed during the greater part of the year, the operation should be timed to secure stumps in fit condition for transplanting during the rainy seasons usually commencing in September and March. No budding should be done during rains as the possibility of moulds entering the wound is increased.

Removal of the Stumps from the Nurseries.

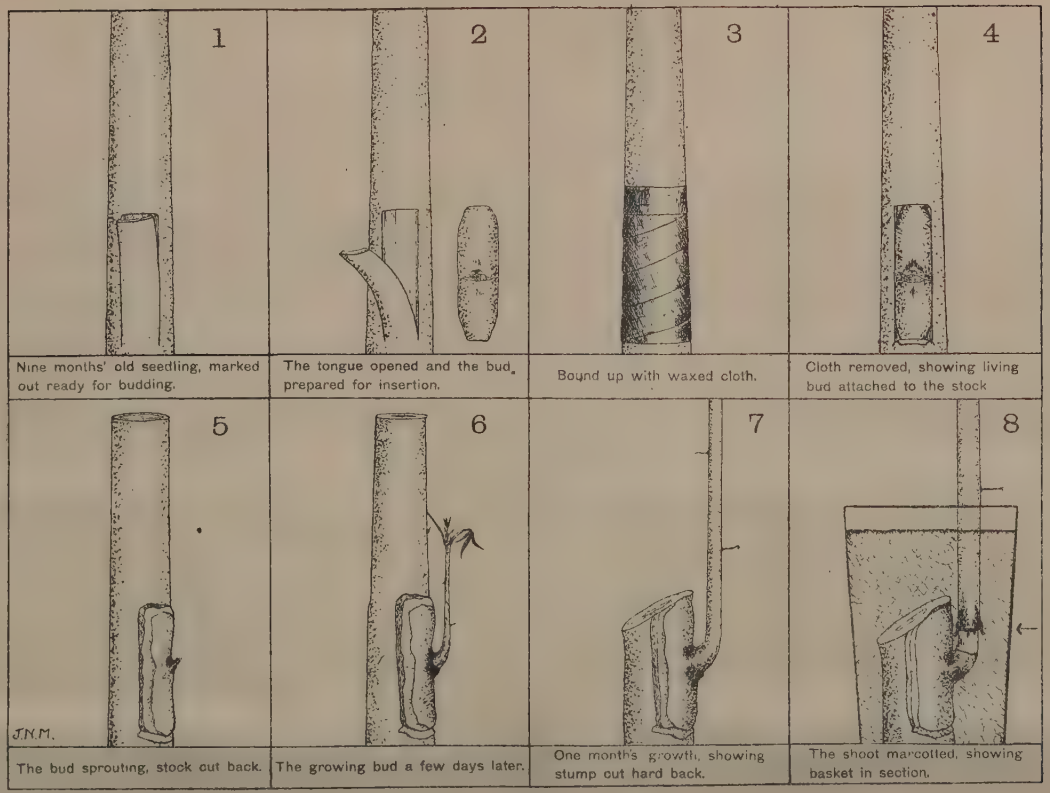
After the bud has become firmly united to the stock, it remains in a dormant condition until some action is taken to force it into development. This may be accomplished by cutting off the upper portion of the stock to within one foot of the dormant bud. The time that may elapse between the removal of the upper part of the stock and the time the bud commences to grow varies considerably according to circumstances. It is usually from 3 to 6 weeks, but frequently a number will take as long as 6 months. The buds obtained from the upper branches of the mother trees have a better sap circulation and usually are more active than those obtained from the lower branches.

The most favourable period to transplant the stump to the field is when the shoot has grown from 1 to 3 inches long, but before any leaves have been formed. Once the eye has commenced sprouting,

1) Agricultural Bulletin, F.M.S., Vol. IX No 2.

(2) Volume 5. No II, p. 509 'De Vegetatieve Vermenigvuldiging van Hevea als Kebonpraktijk'. (In Dutch only.)

TREATMENT OF BUDDED HEVEA SEEDLINGS.


1
2
3
4
Nine months' old seedling, marked out ready for budding.
The tongue opened and the bud prepared for insertion.
Bound up with waxed cloth.
Cloth removed, showing living bud attached to the stock
5
6
7
8
J.N.M.
The bud sprouting, stock cut back.
The growing bud a few days later.
One months growth, showing stump cut hard back.
The shoot marcotted, showing basket in section.

growth is very rapid and it is most important to get the stumps planted in the field without delay. After leaves have been formed, it is necessary to lift the stump with a ball of soil or allow it to remain in the nursery until of sufficient size to treat as in the case of ordinary seedling stumps. The taproot may be shortened and some of the side roots cut away, but as little damage as possible should be done during transplanting.

In Sumatra, wooden frames are employed for removing budded stumps from the nurseries. By this means it is possible to transport 1200 stumps in a Ford truck in one journey. The stumps are covered over and kept as cool as possible : they should be shaded from direct sunshine.

The portion of the stump above the shoot is used as a handle in planting. A few months later, when the stump is established, this piece of wood is sawn off transversely. Donkersloot states that there is really little reason to cut away the wood from above the bud when the shoot is formed as this will fall away later as in the case of seedling stumps. He recommends coating the cut surface with yellow paraffin wax. This substance is said to be far superior to tar in all such operations and it has been found to assist the cambium growing over the wound.

All growths appearing from the base of the stocks must be removed regularly. It is advisable to arrange periodical inspection of the fields for this purpose. Where heavy winds are prevalent, it is often necesaary to place stakes as supports to the shoots. This is especially necessary in the case of large stumps, which cause the shoots to become leafy and topheavy.

Pruning is frequently required as budded trees have a marked inclination to branch low down. Our knowledge of the subsequent behaviour of budded trees is at present incomplete and further investigations are necessary in this respect.

Marcottage.

One of the reasons advanced against the planting of budded stumps from selected trees is that it is at present uncertain whether the latex producing qualities of the trees will remain constant when the trees are on roots other than their own. By the use of marcottage it is possible to have the young trees on their own roots. The operation is quite simple and a high percentage of successes is obtained. The budded stumps are allowed to remain in the nurseries and are marcotted one year after having been budded. Strong stumps may be employed as stocks as the understem is only a temporary feeder.

A ring is made at the base of the scion as close to the junction of the stock as possible. A narrow piece of bark, ¼ inch broad, to the depth of the cambium is removed. A bamboo basket, with the bottom cut away, is placed around the marcot, half under the soil and the other half above. The basket is filled with light rich soil and, in the absence of rain, watered daily. In four months' time roots

will have been formed, and the growth is severed at the junction with the stock, and planted out in the field.

Further investigations are necessary before this system should be employed as an estate practice. Mr. Maas, the Agriculturist at the General Experimental Station of the Algemeene Vereeniging van Rubber planters ter Oastkust van Sumatra, Medan, considers it practicable. Provided the shoots have a good root system before transplanting to the field, there should be few after difficulties. It is obvious that marcottage will result in considerable extra expense and also more time will be necessary before the trees become established. As to whether this is justified by results is a matter for further enquiry. The future prosperity of the rubber producing industry will depend largely on low cost of production. This may be achieved by increased yields.

Bud Wood.

The number of suitable eyes for budding, from any one mother tree, is variable. Ten year old trees examined at the Kuala Lumpur Experimental Plantation showed on an average six suitable eyes to every foot of growth in the upper branches. Donkersloot states that a mother tree will give 500 to 2000 eyes suitable for the purpose of budding. The average number is about 1000 eyes. In selecting the bud wood from the mother trees, care should be taken to use the bud from the thick branches for the largest stumps and buds from thin wood for the smallest.

Branches for the supply of eyes may be kept for a number of days provided the wood is kept cool and away from the sun. Thick branches keep for a longer period than thin, which are liable to dry out early. Experience in Sumatra shows that thick branches will keep for 14 days without any harm to the eyes. They may be kept for a longer period by storage in chests containing damp coconut fibre, charcoal, or sacks. It is necessary to clean out the chests after ten days to make certain that no fungi or moulds are entering. It is known that considerable quantities of bud wood have been imported into the Peninsula from Sumatra, for use in budding on new plantations.

Budding in the Field.

The experience the writer has had of budding in the field has so far not been very satisfactory. This is thought to be due to the fact that the stumps have been too old when budded, and though in the majority of cases, the actual operation of budding has been reasonably successful, the subsequent behaviour of the stumps has been often diappointing. It is to be appreciated that the growth forced from a large stump frequently becomes topheavy and liable to be broken by the wind. This danger may, to a great extent, be minimised by staking the bud shoot. It has been noticed that the foliage on such growth is very delicate and cases of leaf disease have been reported. There appears to be the possibility of serious trouble in this respect.

A further difficulty is encountered when it is desired to re-bud stocks that have failed to sprout after having been cut back. Nine months or more must elapse before fresh growth is made and it is then uncertain what percentage of success may be obtained in the subsequent budding.

In the case of young seedlings in the field, there would appear to be no reason why budding may not be undertaken with success. The coolie should be taught to work with his back to the sun and, after budding, the seedlings must be shaded with circular screens of 'lalang'. On the Holland American Plantation Company's property at Kisarin, tapioca has been used as a shade with much success Several tapioca cuttings are planted around the stump in a circle. five feet in diameter, about four months before the stumps are required for budding. After the buds have sprouted, the tapioca is removed before the plants have had time to form tubers and impoverish the land. Further investigations are necessary to ascertain the relative success of budding seedlings in the field and in nurseries. For the present, the writer favours the latter method, mainly because a regular stand of trees is thus obtained and selection of planting material is possible up to the actual time of transplanting the sprouted stumps to the field.

Planting Distances.

In planting budded Hevea stock, it is to be appreciated that as each tree is theoretically of equal value from the standpoint of latex production, thinning out is not resorted to. On land from which all stumps and roots have been removed it would appear possible to plant 70 to 80 trees per acre, with a reasonable certainty of having a sufficient stand of trees when in bearing. On uncleaned land with the danger of root disease, allowance must be made for loss and it will be neceseary to plant closer. Donkersloot states that the usual number of trees planted per acre is 84.

KAPOK.

By D. H. Grist.

(*Re-print from the Straits Times of 8th July 1922.*)

THE cotton tree (*Eriodendron anfractuosum*) known to the Malays as kabu kabu or ka-kabu is sufficiently familiar to residents in the Tropics to need little description. The tree is readily recognisable by its tall straight trunk, bearing at intervals horizontal branches, which during the fruiting period are devoid of leaves. The value of the tree and its suitability for cultivation in Malaya are less well-known facts.

Kapok is used very extensively as a "filler" for mattresses, pillows and other articles of upholstery, and on account of its buoyancy, and non-matting qualities, it is superior to almost any other filler. Moreover, if the kapok has become hard with much use, it rapidly regains its excellent properties when exposed to bright sunlight. Kapok has also found extended uses during recent years in life-saving apparatus, life-belts, buoyancy cushions and ocean jackets. Its market is also likely to extend when its value is better appreciated as a filler for surgical dressings. For this purpose it possesses the requisite advantages of lightness, elasticity, dryness and suitability for dry sterilisation. Up to the present, kapok has not been found suitable for spinning, owing to its short fibre and extreme brittleness.

Kapok is found in practically all tropical countries, and until recent years had not been considered a crop suitable for plantation conditions. Java practically supplies the world; the exports from that country in 1921 amounted to over seventeen and a half thousand metric tons, exported mainly to the United States of America, Holland, Australia and England. Thus in 1921 Java received about one and a half million pounds sterling for kapok supplied to other countries. Other exporting countries are the Philippine Islands, Ceylon, India, and Venezuela (where the finest quality is said to grow.) The standard kapok comes from Java and is known as Prime Samarang. The prices vary from 4d. per lb. for Indian kapok to 13d. per pound for that originating from Java and Venezuela. The interesting point in the production of kapok in most countries is that practically in every case the cultivation is in the hands of natives, the foreigner managing the marketing.

A census of the trees in the Federated Malay States and the Straits Settlements has been made with the result that it is ascertained that although almost all districts contain trees, the amount of kapok obtained is insufficient to meet the local demand. The exceptions to this were in Lower Perak, Kuala Kangsar and Krian Districts, which together contained about sixty thousand trees. The purchase of kapok by Chinese has yielded such poor returns to the Malay growers that the latter sell but a small proportion of their crop, and much of the

kapok is allowed to rot in situ. There are about 10,000 trees only in the Straits Settlements. Perak holds out the best hopes of establishing a native industry in this commodity, and the Department of Agriculture is taking steps to organise this at an early date.

Kapok will flourish in a wide range of soils, but those of a light friable nature, allowing easy development of the somewhat sparse root system, are preferable. In this country, the alluvial soils along river banks give the best returns, after which a sandy loam is suitable. In Java, the finest crops are obtained from the well-weathered volcanic soils of Samarang. Whatever be the soil, the drainage should be good, although occasional floods over the area do not appear adversely to affect the trees. In fact, the Malays state that the tree flourishes best on land periodically flooded. Hill land or any land very subject to white ants is less suitable, as white ants are the most serious pest of kapok trees in this country.

The methods of cultivation of kapok must be judged mainly from general agricultural experience rather than actual knowledge of plantation conditions for this crop, for apart from new plantations in the Philippine Islands and in Java, the crop has not been planted on a large scale.

The land should be well cultivated, and kapok seed planted, "seed to stake," there being two or three seeds per hole. The best planting distance is twenty feet square; which allows just sufficient room for the branches, and space for other cultural operations between the rows. Some writers advocate raising the seed in a nursery, but from his own observations, the writer doubts whether such a course is sufficiently compensated by increased yield. Growth is very rapid, and a selection of the particular seedling to be left must be made at an early stage. In so far as the kapok tree is concerned, no further cultural operations are considered necessary, although it is of advantage to the tree to retain the soil in a state of cultivation. It must be remembered too that when the tree comes into bearing, the ground must be fairly clear to facilitate harvesting operations. Kapok may also be planted from branch or stem cuttings, but this practice carries with it many objections. The trees thus propagated will commence bearing about one season before trees obtained from seed, but such trees are more liable to the attack of white ants, are more likely to fall in high winds owing to the absence of tap-roots, and have a much shorter life than trees obtained from seed.

The trees commence bearing in about four years from planting, when a small crop of perhaps fifty pods per tree might be expected. Thereafter the increase in crop is very rapid. Fruiting takes place once annually, after the rains. At this season the leaves drop off and for three or four months the tree is without foliage and is ripening its fruit. One can but estimate probable crops. A plantation of about eight years would probably give an average of 400 pods per tree. The life of the tree, planted from seed, may be as much as fifty years. The writer has seen trees of 35 years of age yielding over 1,000 pods per annum, and under plantation conditions such yields should be quite possible in younger plantations.

In Java, the pods are not harvested, but are picked from the ground immediately they have fallen. In Malaya, with more uncertain seasons, ripe pods are more liable to persist on the tree, and must therefore be harvested before rain and dew deteriorate the floss. This does not present great difficulties, but care should be taken to insure that only ripe pods are harvested.

The following is an average composition of dry ripe pods.

Husks and Placentas	44 per cent.
Seeds	35 ,,
Floss	21 ,,

It is generally estimated that one hundred pods will produce 1 lb. of clean kapok.

Kapok seed contains over 20 per cent. of oil. Large quantities of seed are exported annually from Java. In 1912, nearly 300,000 piculs of seed were exported from Java, valued at about $600,000. The oil is employed in soap making and as an adulterant of other oils. The cake or meal, after expression of the oil from the seed, is a useful cattle food or fertilizer.

Much of the kapok from Java is cleaned or partly cleaned by hand; but in order to obtain first class floss, its subsequent treatment by machinery is necessary. The universal method of cleaning by natives is to place the pods, after removal of the husks and placentas, into a barrel and to cause to revolve a forked bamboo in the kapok. This opens up the floss so that the seeds fall to the bottom of the barrel. All the types of machines work on the same principle. Instead of the barrel, the machine consists of a chamber set horizontally or perpendicularly. Through this chamber runs a shaft provided with blades. From the sides of the chamber other blades extend, placed in such a way that they pass an inch or so in front of the revolving blades of the shaft. In the Philippine bulletin on the Kapok Industry three such machines are described, but there is a lack of detail of makers of such machines and cost of same. Messrs. Ernest Lehmann, Engineers, Manchester are the makers of a machine for ginning cotton, which they claim is also adapted for ginning Kapok. This machine can be obtained for hand or belt power. The Hand Machine will produce about 12 lbs. of clean floss per hour, while the largest size Belt Power Machine will produce about 1200 lbs. of clean floss per day. The power required for the belt machine is very little—not more than 1 h.p. The prices of such machines vary from £60 to £92. The Bley kapok ginner is said to be one of the best machines so far invented: It requires one-half to one horse power for its operation and is claimed to clean 217 kilos per hour. This machine was exhibited and operated at the Surabaya Fibres Congress and Exhibition 1910 and was awarded first prize. It may be obtained from Lindetevas Stockvis, Batavia for about $200.

It is urged that kapok prepared for export must be free of seed, and for this purpose hand labour will prove too expensive.

Messrs. Lehmann also advertise a kapok cleaning machine. This is constructed for the purpose of opening out kapok, which has been gathered from the field and stored in the godown, or which

has been press-packed in bales and exported. It is said to open out every particle of the material and to free it of all dust, knotty matter, hards, lumps and other impurities, leaving the material in a light and loose condition, ready for upholstery and other purposes. These machines are made in two sizes, one for steam power and the other for hand power. The former will treat about 2,000 lbs. daily; requires 1 ¾ h.p. and costs £305. The latter treats 200 lbs. daily and costs £110. It should be pointed out that the machine described above is not a necessity from the producers point of view, as the mills in England treat the kapok in this way if not already so treated.

Kapok is exported in bales, and for this purpose a baling machine is essential. Balers cost from £24 to £100 and more. Interested readers are advised to correspond with the Department of Agriculture on this point or to obtain information on balers from Messrs. Hollings and Guest, Ltd., Timble Mill Lane, Birmingham,

Baling is essential to economise in shipping freights. The size of bale prepared varies according to the market to which the kapok is to be exported. For European shipment the bale is 1.70 piculs or 217.6 lbs.; for Australian shipment 1.20 piculs per double bale and 0.80 picul per single bale. Baling is best pressed into sacking or matting and bound with fibre.

There is a world-wide demand for kapok. The principal countries of import are Holland, America, Australia and New Zealand, and England. The Department of Agriculture is in a position to place sellers of kapok in touch with some fifty buyers in all parts of the world. The present price of Prime Samarang is about 12½d. per lb. Second and third quality kapok is placed on the market at present prices from 4d. to 9d. per lb.

The object of this article is to bring to the notice of planters and others the commercial possibilities of the cultivation of the kapok tree in Malaya. Kapok is one of the few crops which does not appear to have been affected by the slump; the price for many years has been steady, and with constantly increasing demand as its floss becomes better known and more appreciated as a filler, together with the possibility of new uses, it appears probable that the market will remain firm for a considerable time. The outlay in establishing the crop and upkeep charges are small, and the machinery required, for preparing the floss for market, inexpensive. Moreover, any estate provided with machinery can attach kapok cleaning machinery to their shaft, as the horse-power required is small. The great advantage of kapok cultivation is that the land, in addition to bearing mature kapok trees can, by reason of the little shade thrown by such trees, be utilized for a wide range of additional crops. In Java, vanilla, coffee, cocoa are frequently grown in this way. In Perak, limes are frequently so grown with success. The possibility of establishing a rotation of fibre crops under kabu is worthy of consideration. The more fibre crops that can be grown in conjunction with kabu the better, as the balers are more constantly in use.

The quality of fibre from Malayan trees compares very favourably with that produced by Sumatra, and it is probable that with better local methods of cultivation and the introduction of machinery, this country can produce kapok equal to that of Java.

The Department of Agriculture has extended their enquiries over many months on the cultivation of kapok, machinery, marketing, supply and demand, prices etc., and is in a position to give those interested more detailed information than is possible in this place. Enquiries will therefore be welcome at any time, and personal interviews arranged for as far as possible. All enquiries should be addressed to the Secretary for Agriculture, Department of Agriculture, Kuala Lumpur.

ENTOMOLOGICAL JOTTINGS.

By G. H. Corbett.

Plesispa nipa, Maulik.

THIS insect, which is a new species of Hispid beetle, was found near Malacca on nipah (*Nipa fruticans*) and rembia (*Metroxylon sagu*).

Plesispa reichei, a pest of young coconut palms and *Plesispa nipa* resemble each other so closely that they may be easily confused. There are structural differences but if the species are compared it will be noticed that the thorax and abdomen of *Plesispa nipa* are reddish whilst the thorax is yellowish and the abdomen blackish of *Plesispa reichei*.

Plesispa nipa causes similar injury to nipah palms as *Plesispa reichei* to coconut palms.

It is interesting to note that whilst the eggs of *Plesispa reichei* are always laid singly, those of *Plesispa nipa* are deposited in groups.

Astychus Chrysochloris.

This weevil is generally distributed throughout Malaya. The insects are golden green in colour, but, on account of the golden scales being rubbed off, some appear greyish black.

The adults eat the leaves of a variety of plants such as rubber, limes, and castor, but the cause of the damage is frequently unobserved owing to the " hide and seek " habits of the insect on the leaves.

The eggs which are laid in the soil hatch in about seven days.

A female observed laying eggs in the soil in the Insectary deposited 16 eggs in 21 minutes.

Dysdercus Cingulatus.

This insect is one of the cotton stainers but besides cotton is frequently seen on ladies' fingers, roselle, and similar plants.

The yellowish eggs are laid usually in the soil and hatch in about one week. The time taken for the emerged wingless nymphs to become winged adult bugs is about seven weeks.

The bugs are conspicuous and may be collected by hand or shaken into a bag fitted with a tin funnel.

Leaves of ladies' fingers showing holes in the tissue together with specimens of *Dysdercus cingulatus* were received by the Department, and it was thought that this insect was responsible for the damage.

Both nymphs and adults are only able to puncture the tissue of plants and derive nutriment by sucking the sap. They are not capable of eating holes in leaves.

The injury to the leaves was probably caused by a beetle which hides during the day time in the soil.

ATLAS MOTH. (*Attacus atlas.*)

A female of the Atlas moth which was caught in the field during the month deposited 507 eggs.

The eggs are brownish in colour and should be hand collected. The caterpillars are frequently found on soursop, candle nut, guava, camphor and limes.

RUBBER FLOWER GEOMETRID. (*Hemithea costipunctata*).

Caterpillars of this moth are being collected daily in The Gardens, Kuala Lumpur.

They are difficult to detect but if the flowers are carefully examined their presence should be observed.

A few other caterpillars and bugs have been noted on the inflorescences.

LIMES.

Numerous insects injure the foliage and fruit of lime trees.

A plant which is thoroughly healthy will often escape attack or will suffer comparatively little, whilst a weakly one will be attacked more readily and its fruit reduced a greater amount.

It is not suggested that healthy lime trees will not be attacked by insects, but there is no doubt that the reason why some lime trees are badly attacked is that they are growing in unhealthy conditions.

Cultivating and manuring of some of the lime trees in Malaya should help the trees to withstand to a greater extent the ravages of pests.

RHYNCHOPHORUS SCHACH.

This beetle pest of coconuts in Malaya in Entomological writings will be referred to in future as the "Red Stripe" weevil and not the "Red" Weevil, for the obvious reasons that it is not red but black and possesses a red stripe on the dorsal surface of the prothorax.

In connection with the work on this insect, a one day old grub placed in the end of a cut petiole of a coconut leaf at a distance of one yard from the trunk ate its way down inside the petiole and was found in the trunk.

A PADI "BORER."

The caterpillar "borer" of padi, which is being investigated in the Krian district and has not been previously recorded in Malaya, has been identified by Dr. Guy A. K. Marshall as *Diatraea Auricilia Dudgeon.*

The eggs of this insect which are laid in groups on the leaves of padi have been observed parasitised.

CANDLE NUT TREE. (*Aleuritis sp.*.)

"Slug" caterpillars of different species have been noted damaging this economic plant:

PRODENIA LITURA.

Six hundred and one caterpillars hatched from one egg mass of this insect collected from castor.

This insect has a large variety of host plants. The eggs are laid in groups on the leaves and are made conspicuous by a covering of buff coloured hairs derived from the body of the female moth.

The eggs hatch in about 3 days and the caterpillars live gregariously for a short time before separating to different parts of the plant. When the caterpillars are full grown, usually in about twenty days, they enter the soil for pupation. The adult moth emerges from the pupa in about seven days.

Collection of egg masses and caterpillars should be done on their first appearance. Spraying with an arsenical spray might be necessary to control this insect.

THE GREATER COCONUT SPIKE MOTH.

Observations concerning the habits and control of this important pest of coconuts have been occupying the attention of the entomological officers for the past few months.

One of the causes for the spike failing to produce nuts is the caterpillar of the greater coconut spike moth.

The moth has a wing expanse of about $\frac{3}{4}$ inch. The fore wings are green between the veins and red above the veins. The hind wings are golden yellow in colour.

The adult lays her eggs singly on the spikes mostly in places where the buds overlap one another. They resemble the colour of the spike. They hatch in from three to six days.

Preliminary breeding work indicates that the minimum length of time from egg to adult is 28 days and the maximum 43 days.

The larvae usually feed on the male flowers of the spike. They are active and form a gallery of excrement through which they advance or retire when disturbed.

Pupation takes place on the spike or on the spathe or at the base of the spike where, owing to the fallen buds collecting there, the larvae are able to develop.

All badly attacked spikes should be entirely removed and burnt and the trees should be cleaned of accumulated fallen buds.

Spraying and dusting experiments are being carried out with a view to the control of this insect.

THE LESSER COCONUT SPIKE MOTH.

The damage caused by this moth to both female and male flowers is done before the spathe opens.

The white cocoons may be seen at the base of the spike and occasionally on opening the spathe, moths emerge.

As far as the writer is aware injury to the inflorescence of the coconut at this stage caused by the caterpillars of this moth has not been previously recorded.

THE PADI "FLY"—(*Leptocorisa varicornis*).

This well known pest of the ripening padi grain is under observation at present, and considerable information has been accumulated.

Besides padi this insect has been successfully bred from egg to adult on the ripening seed of various grasses which may be commonly found in padi areas.

Insects have reached the adult winged condition after the nymphs emerged from the eggs on the forming seeds of *Panicum cotonum* in 16—18 days, and *Paspalum conjugatum* in 19—20 days.

Leptocorisa feeds on grasses especially when there is no ripening padi in the field and in the control of this insect it is particularly advisable to prevent the grasses in the vicinity of padi flowering.

NOTES ON "RUST" IN SMOKED SHEET.

By B. J. Eaton.

Cause of Rust:—The defect known as "Rust" on smoked sheet is caused by an exudation of the soluble non-caoutchouc serum products in the latex, which come to the surface, while the sheet is contracting, after being machined, during the early stages of drying and smoking.

The aqueous liquid, which exudes from the interior of the freshly machined sheets, settles especially in the diamond depressions of ordinary diamond marked sheet and evaporates in these, forming a thin film which sometimes become glossy when the sheet is smoked and dried.

This film is very thin and cannot be removed by washing after the rubber is dry, since it adheres to the rubber.

On stretching or scratching the sheet however, the film is broken up and appears as a "rusty" incustation or powder on the surface. The film is usually so thin that no particles can be removed from the surface.

Predisposing Influences:—

(a) "Rust" is more likely to occur on smoked sheet, if a very concentrated latex is used in the preparation of the sheet, since the concentration of the serum, which exudes from the interior, is greater.

(b) "Rust" is likely to occur especially on the lower sheets and on the edges of such sheets, if a big pile of sheets is stacked on a table, after being machined.

(c) "Rust" is likely to occur if the sheets are not allowed to drip and are not washed or soaked in water after being machined and allowed to drip before placing in the smoke house.

(d) "Rust" is probably also seasonable to a certain extent.

Remedies:—The predisposing influences to the occurrence or formation of rust, as given above, will indicate the remedies to be applied which are as follows:—

"If the rust is due to the use of too concentrated a latex, dilution of the latex must be effected."

"It is recommended that the final latex used in the preparation of sheet should contain between 1¼ and 1½ lbs. of dry rubber per gallon."

Sheet from strong latex is preferable, from the point of view of intrinsic quality, but since the brokers object to "rust", it is essential that the producer should dilute his latex for the manufacture of sheet, if "rust" occurs.

The practice of piling sheets in a large stack on a flat table after machining should be avoided. All sheets should be hung separately on a rack, immediately after machining, so that the watery serum, which exudes as the sheet contracts, can drip off.
After allowing the sheets to drain as above for about an hour they should be soaked in running water or placed in two or three changes of water in large tanks and again allowed to drain on racks for about an hour, before being placed in the smoke house.
The smoke house should be ventilated and dry fuel should be used for smoking. "Rust" can be eliminated by placing the sheets, after machining, to dry in the sun for an hour or two before placing them in the smoke house. This practice however is not recommended if the "rust" can be eliminated by the washing method described above.

NOTE:—According to some authorities "rust" is produced by the decomposition of the serum products which exude and remain on the surface of the sheet. This point however is not very material and is not believed to be the cause in all cases of rust. The exudation of the serum and its evaporation on the surface is sufficient to cause "rust", irrespective of any bacterial decomposition of the film.